CALFED WATER QUALITY

PRELIMINARY LOADING ANALYSIS

CONTENTS

Prepared for

CALFED
BAY-DELTA
PROGRAM

CALFED Water Quality Action Team
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PRELIMINARY LOADING ANALYSIS

INTRODUCTION AND PURPOSE

The purpose of the analysis is to estimate the loads of various pollutants discharged to water bodies within different portions of the CALFED study area. The pollutants of interest are the key contaminants identified by the CALFED advisory committees. Load estimates were made for four regions, the Sacramento River Basin, the San Joaquin River Basin, the Delta, and the Bay Region. The Sacramento River Basin estimates were further subdivided into loads generated above and below the three major dams, Shasta, Oroville and Nimbus.

In a later task in the CALFED program, the load estimates will be used to determine the relative importance of different pollutant sources and the effectiveness of potential control measures. For example, it may be determined that municipal and industrial wastewater treatment plants contribute less than 5% of the copper discharges to the Delta. It is apparent from the loading estimate described above for copper that additional measures to reduce copper from this source are unlikely to greatly affect copper concentrations in the Delta.

ANALYTICAL APPROACH AND ORGANIZATION OF INFORMATION

Considerable information on pollutants discharged to the Sacramento River Basin, the San Joaquin River Basin, the Delta, and the Bay Region and pollutant concentrations in various water bodies is available but it is not found in a single depository. Developing a comprehensive picture of pollutant loadings involves compilation of potentially-relevant data from published and unpublished sources, review of the data by the consultant team and, in many cases, further manipulation of the data into the form of load estimates.

Pollutant load estimates are difficult to make for large geographical areas because data is always limited and many assumptions have to be made. The approach used here was to try to make fairly complete load estimates for the various contaminants even if fairly gross assumptions have to be made. The load estimates will then be progressively refined as additional data is acquired and analyses completed.

The following analytical report includes a number of separate sections addressing each key contaminant. Each section consists of a tabular and graphical summary of loading data and a series of notes. The notes describe the data sources and any analyses undertaken by the consultant team to produce the load estimates.

Two approaches to load estimation were used and their results compared in the tabular and graphical summaries. The first approach was to estimate the load attributable to each major source and then to sum the loads up to provide a total basin load. Major contaminant source categories include agricultural stormwater runoff and subsurface drainage, mine drainage, municipal and industrial wastewater discharges and urban stormwater runoff. The second approach was to estimate the total pollutant emission from a basin by calculating the load contained in water exiting the basin at its downstream end. The loads calculated using the two approaches are not directly comparable because some of the pollutants discharged to waterways in a basin may be stored in sediments and biota or transformed into other substances, as a consequence of chemical reactions and biological activity.

LIMITATIONS

Because of the many assumptions and simplifications involved in the load estimates the results need to be used with caution. The more important assumptions and simplifications are noted below.

Year-to-year variations

Most contaminant sources are affected by meteorological conditions. The total contaminant loads from agricultural and urban runoff depend on the volume of runoff which can vary widely from year-to-year. Mine drainage loads are similarly weather-dependent. Waste loads associated with municipal and industrial wastewater discharges are less affected by weather; the same may be true for waste loads in agricultural subsurface drainage which probably depend more on irrigation rates than precipitation.

Because the data available to characterize contaminant loads is limited it was not separately compiled for different meteorological conditions. Ideally, loads should be separately estimated for wet, normal, dry and very dry years. Instead data from different years, representing different meteorological conditions were compiled to produce a single load estimate that may approximate "typical" conditions.

Seasonality of loadings

Most contaminant emissions vary seasonally. The initial load estimates contained in this report were made on an annual basis. If the available data allows, later refinement of the load estimates will seek to account for seasonality.

Background loads

The load estimates do not attempt to account for background loads. Many substances regarded as contaminants occur at low concentrations in waters uninfluenced by human activities. This is the case for metals and trace elements, salts, naturally-occurring organic substances and plant nutrients. It is not so for synthetic organic including pesticides.

The lack of allowance for background loads probably does not greatly affect load estimates for relatively concentrated waste streams. If, for example, a city draws water from a river, uses it for municipal supply and discharges it back to the river after wastewater treatment then the phosphorus load attributable to the municipal wastewater discharge is the load contained in the effluent less the background load contained in the source water. In this case, the background phosphorus concentration might be 0.05 mg/l while the concentration of phosphorus in the wastewater effluent would be 5 or 10 mg/l. The phosphorus load would be similar whether or not the background concentration is allowed for.

Lack of an adjustment for background loads can have a greater effect on loads attributable to dilute, but high-volume, waste streams. For example, copper concentrations in agricultural runoff may be estimated to be 0.01 mg/l while copper concentrations in runoff from non-agricultural lands with similar soil chemistry characteristics may be 0.005 mg/l. Not accounting for the background concentration in the load calculations would result in an overestimation of loads attributable to agricultural runoff by a factor of 2.

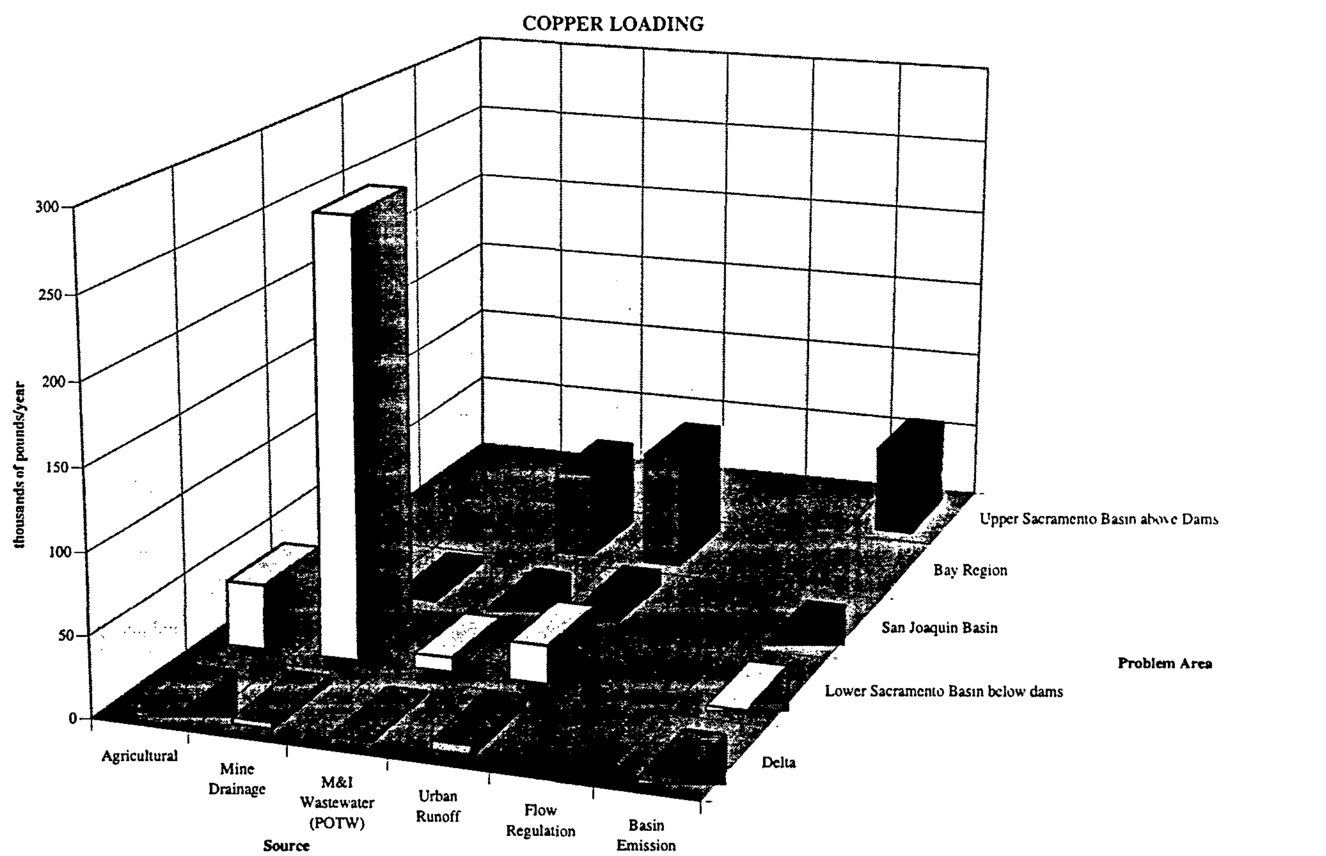
CONSTITUENT SELECTION TABLE											
		Ecological/Human Health									
		303(d) List									
Type	Constituent	Delta	Sacramento Basin	San Joaquin Basin	Bay Region	Sacramento R. (above dams)	Drinking Water	Agricultural Water	Industrial	Recreational	LOADING LIST
Metals	As										
	Cd	■	■		■	■					■
	Cr										
	Cu	■	■	■	■	■					■
	Hg	■	■	■	■	■					■
	Pb										
	Ni										
	Zn	■	■	■	■	■					■
Trace El.	selenium	■		■	■						■
	boron			■				■	■	■	■
Organics	TOC						■				■
	DOC										
	THM										
	THMFP										
	TFPC										
Pesticides	DDT	■		■							■
	carbofuran		■								■
	chlordane (A)	■	■	■							■
	chlorpyrifos	■	■	■							■
	diazinon	■	■	■							■
	toxaphene (A)	■	■	■							■
	PCBs		■								■
	endosulfan (A)			■							■
Salts	TDS			■			■	■	■	■	■
	salinity	■		■				■	■	■	■
	SAR							■	■	■	■
	bromide						■				■
	chloride							■	■	■	■
Biotic	pathogens				■	■	■				■
Nutrients	nitrate	■			■	■	■	■	■	■	■
	phosphorous										
	ammonia	■		■							■
Other	DO	■		■							■
	turbidity				■		■	■	■	■	■
	temperature		■					■	■	■	■
	unk. toxicity	■	■	■							■
	pH					■		■	■	■	■
	alkalinity							■	■	■	■
	sediment.		■								■

SOURCE SELECTION TABLE

Type	Constituent	Agricultural	Mine Drainage	M&I Wastewater (POTW)	Urban Runoff	Flow Regulation	Dams	Dairies	Construction	On-site Disposal	Marinas
Metals	As										
	Cd	■	■	■	■	■					
	Cr										
	Cu	■	■	■	■	■					
	Hg	■	■	■	■	■					
	Pb										
	Ni										
	Zn	■	■	■	■	■					
Trace El.	selenium	■	■	■	■	■					
	boron	■									
Organics	TOC										
	DOC										
	THM										
	THMFP										
	TFPC										
	chlorpyrifos	■			■						
Pesticides	DDT	■									
	carbofuran	■									
	chlordane (A)	■			■						
	diazinon	■			■						
	toxaphene (A)	■									
	PCBs			■	■						
	endosulfan (A)	■									
Salts	TDS	■									
	salinity	■			■	■		■			
	SAR										
	bromide										
	chloride										
Biotic	pathogens	■			■				■	■	■
	viruses										
Nutrients	nitrate	■			■	■			■		
	phosphorous										
	ammonia	■		■				■			
Other	DO	■		■	■	■	■	■	■		
	turbidity	■			■						
	temperature						■				
	unk. toxicity										
	pH		■								
	alkalinity										
	sediment.		■								

COPPER LOADING TABLE											
	Copper Loading (thousands of pounds/year)										
Source	**Delta**	**Note**	**Lower Sacramento Basin below dams**	**Note**	**San Joaquin Basin**	**Note**	**Bay Region**	**Note**	**Upper Sacramento Basin above Dams**	**Note**
Agricultural	B	*1*	41	*6*	B	*11*		*16*		
Mine Drainage	4	*2*	274	*7*	4	*12*		*17*		
M&I Wastewater (POTW)	2	*3*	9	*8*	A	*13*	55	*18*		
Urban Runoff	6	*4*	24	*9*	9	*14*	73	*19*		
Flow Regulation										
Total Load			348		13		128			
Basin Emission	A	*5*	B	*10*	A	*15*		*20*	56	*21*

Note: Numerical values listed in italics under the Note column provide the background and references associated with the accompanying load
A - Data available; flow and concentration data available; load calculations required.
B - Further literature review required.
[ ] - Source does not contribute significant load of constituent in this watershed.



Copper Loading Notes

1. Further literature review required.

2. The original data for the load estimate was obtained from "A mass loading assessment of major point and non-point sources discharging to surface waters in the Central Valley, California, 1985" prepared by the RWQCB Central Valley Region in 1988. Flow and load data was compiled for four inactive mines including Iron Mountain, Newton, New Idria and Afterthought Mines. Only mines that drain to the Sacramento River or its tributaries below Shasta, Oroville and Nimbus Dams were considered. Ninety-five percent of the load was from Iron Mountain. A later report by Central Valley RWQCB prepared in 1989 and entitled "A mass loading assessment of major point and non-point sources in the Sacramento Valley, California, 1985" estimated that the earlier mine drainage estimate only represented 25% of the total. A further review of the two RWQCB documents was made by Woodward-Clyde in light of information contained in a 1992 report by the Central Valley Board entitled "Inactive mine drainage in the Sacramento Valley". Data in this report suggests that Iron Mountain represents about 50% of the total copper load from inactive mines. The 50% estimate was used to scale up the loads originally calculated by RWQCB. The loads calculated in the 1988 RWQCB were segregated into the three geographical areas, delta, San Joaquin Basin and Sacramento Basin below dams.

3. The original data for the load estimate was obtained from "A mass loading assessment of major point and non-point sources discharging to surface waters in the Central Valley, California, 1985" prepared by the RWQCB Central Valley Region in 1988. Flow and load data was compiled from several NPDES dischargers who have been monitoring copper. including the largest in the Central Valley the Sacramento Regional County Sewer District. Woodward-Clyde divided the results into two geographical areas, the delta and the Sacramento Basin. A later report by Central Valley RWQCB prepared in 1989 and entitled "A mass loading assessment of major point and non-point sources in the Sacramento Valley, California, 1985" estimated that the earlier M and I estimate only represented 50% of the total. This percentage was used to scale up the loads.

4. The original data for the load estimate was obtained from "A mass loading assessment of major point and non-point sources discharging to surface waters in the Central Valley, California, 1985" prepared by the RWQCB Central Valley Region in 1988. Urban runoff estimates were made for 19 large cities in the Central Valley. Flow data was calculated using rainfall data for cities, urban acreage and a runoff factor of 0.3. Quality data for the city of Sacramento was used for all cities. A later report by Central Valley RWQCB prepared in 1989 and entitled "A mass loading assessment of major point and non-point sources in the Sacramento Valley, California, 1985" estimated that the earlier urban runoff estimate only represented 35% of the total. A further review of the original data by Woodward-Clyde concluded that the original estimate probably captured 70% of the load, because all major urban areas were included in the calculations. The 70% figure was used to scale up the original estimates. The data allowed separation of the loads into three geographical areas, the delta, San Joaquin Basin and the Sacramento Basin.

5. Copper concentrations are available from various sampling locations within the Delta and at the San Joaquin River inflow to the Delta. Most of this data can be found at the Interagency

Ecological Program web site. Work is in progress to acquire matching discharge data and calculate loads.

6. The original data for the load estimate was obtained from "A mass loading assessment of major point and non-point sources discharging to surface waters in the Central Valley, California, 1985" prepared by the RWQCB Central Valley Region in 1988. Flow and concentration information was compiled for the major drains in the Sacramento Basin, including Sacramento Slough, Colusa Basin Drain, RD1000, RD108 and Natomas East Main Drain. A later report by Central Valley RWQCB prepared in 1989 and entitled "A mass loading assessment of major point and non-point sources in the Sacramento Valley, California, 1985" estimated that the earlier agricultural runoff estimate only represented 80% of the total. This percentage was used to scale up the estimates.

7. See Note 2 for explanation.

8. See Note 3 for explanation.

9. See Note 4 for explanation.

10. See Note 1 for explanation.

11. See Note 1 for explanation.

12. See Note 2 for explanation.

13. Data available; flow and concentration data available; load calculations required.

14. See Note 4 for explanation.

15. See Note 5 for explanation.

16. Source does not contribute significant load of constituent in this watershed.

17. See Note 16 for explanation.

18. Reported in Table 19 of "State of the Estuary: A report on conditions and problems in San Francisco Bay/Sacramento-San Joaquin Delta Estuary' San Francisco Estuary Project, 1992. Middle of range of values used .

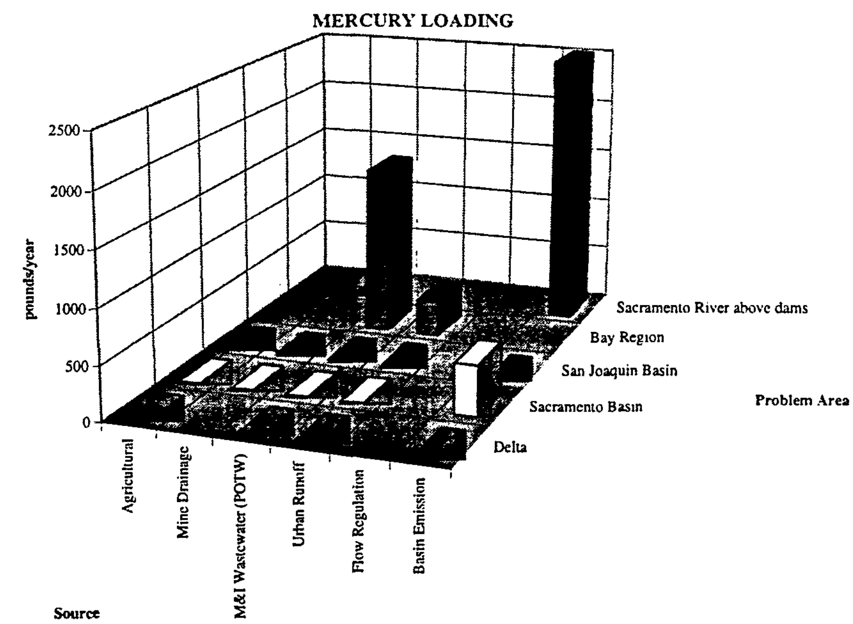
19. See Note 18.

20. See Note 16 for explanation.

21. Total emission from upper Sacramento Basin was calculated using flow and concentration data for releases from Shasta, Oroville and Nimbus Dams. Reported in "A mass loading assessment of major point and non-point sources discharging to surface waters in the Central Valley, California, 1985" prepared by the RWQCB Central Valley Region in 1988.

MERCURY LOADING TABLE										
	Mercury Loading (pounds/year)									
Source	**Delta**	**Note**	**Sacramento Basin**	**Note**	**San Joaquin Basin**	**Note**	**Bay Region**	**Note**	**Sacramento River above dams**	**Note**
Agricultural	B	*1*	B	*6*	B	*11*		*16*		
Mine Drainage		*2*	B	*7*	B	*12*		*17*	B	*21*
M&I Wastewater (POTW)	B	*3*	B	*8*	B	*13*	1543	*18*		
Urban Runoff	B	*4*	B	*9*	B	*14*	330	*19*		
Flow Regulation										
Total Load							1873			
Basin Emission	A	*5*	463	*10*	A	*15*		*20*	2500	*22*

Note: Numerical values listed in italics under the Note column provide the background and references associated with the accompanying load
A - Data available; flow and concentration data available; load calculations required.
B - Further literature review required.
- Source does not contribute significant load of constituent in this watershed.



Mercury Loading Notes

1. Further literature review required.

2. A report prepared by the Central Valley RWQCB in 1992 and entitled "Inactive mine drainage in the Sacramento Valley" did not estimate mercury loads because sites visited were dry and not discharging wastewater. Mercury loads from the Newton and New Idria Mines were estimated as very small (less than 3 lbs/year) in "A mass loading assessment of major point and non-point sources discharging to surface waters in the Central Valley, California, 1985" prepared by the RWQCB, Central Valley Region in 1988. Although inactive mines could contribute mercury in surface runoff, it is unlikely that represent a significant source.

3. See Note 1 for explanation.

4. See Note 1 for explanation.

5. Mercury concentrations are available from various sampling locations within the Delta and at the San Joaquin River inflow to the Delta. Most of this data can be found at the Interagency Ecological Program web site. Work is in progress to acquire matching discharge data and calculate loads.

6. See Note 1 for explanation.

7. See Note 1 for explanation.

8. See Note 1 for explanation.

9. See Note 1 for explanation.

10. Total emission in Sacramento River as measured at Freeport. Reported in "Sacramento River Mercury Control Planning Project, Final Project Report" prepared for Sacramento Regional County Sanitation Agency by Larry Walker and Associates, 1997.

11. See Note 1 for explanation.

12. See Note 2 for explanation.

13. See Note 1 for explanation.

14. See Note 1 for explanation.

15. See Note 5 for explanation.

16. Source does not contribute significant load of constituent in this watershed.

17. See Note 16 for explanation.

Mercury Loading Notes

18. Reported in Table 19 of "State of the Estuary: A report on conditions and problems in San Francisco Bay/Sacramento-San Joaquin Delta Estuary' San Francisco Estuary Project, 1992. Middle of range of values used .

19. See Note 18.

20. See Note 16 for explanation.

21. See Note 1 for explanation.

22. Emission was calculated using flow and concentration data for release from Shasta Dam. No similar data was available for Oroville and Nimbus Dams so this is probably an underestimate. Reported in "A mass loading assessment of major point and non-point sources discharging to surface waters in the Central Valley, California, 1985" prepared by the RWQCB Central Valley Region in 1988. The emission is the product of a large flow and a small concentration, probably based on limited data. Consequently, a small error in concentration can greatly effect the emission rate.

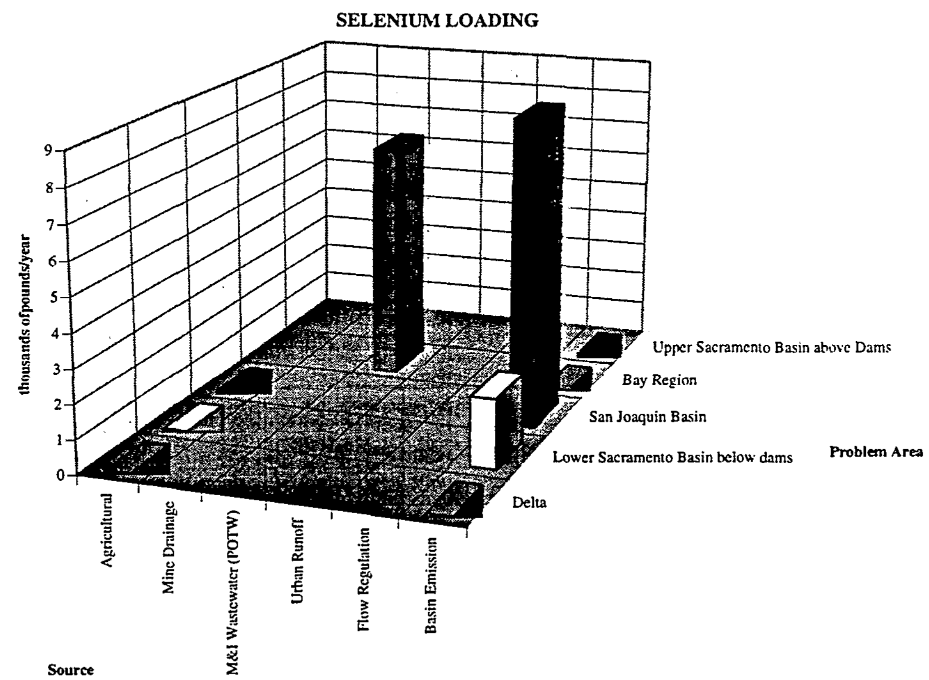
SELENIUM LOADING TABLE - 1										
	Selenium Loading (thousands of pounds/year)									
Source	Delta	Note	Lower Sacramento Basin below dams	Note	San Joaquin Basin	Note	Bay Region	Note	Upper Sacramento Basin above Dams	Note
Agricultural	A	*1*	A	*6*	A	*11*		*16*		
Mine Drainage		*2*		*7*		*12*		*17*		
M&I Wastewater (POTW)		*3*		*8*		*13*	7	*18*		
Urban Runoff		*4*		*9*		*14*		*19*		
Flow Regulation										
Total Load							7			
Basin Emission	B	*5*	2	*10*	9	*15*	B	*20*	B	*21*

Note: Numerical values listed in italics under the Note column provide the background and references associated with the accompanying load

A - Data available; flow and concentration data available; load calculations required.

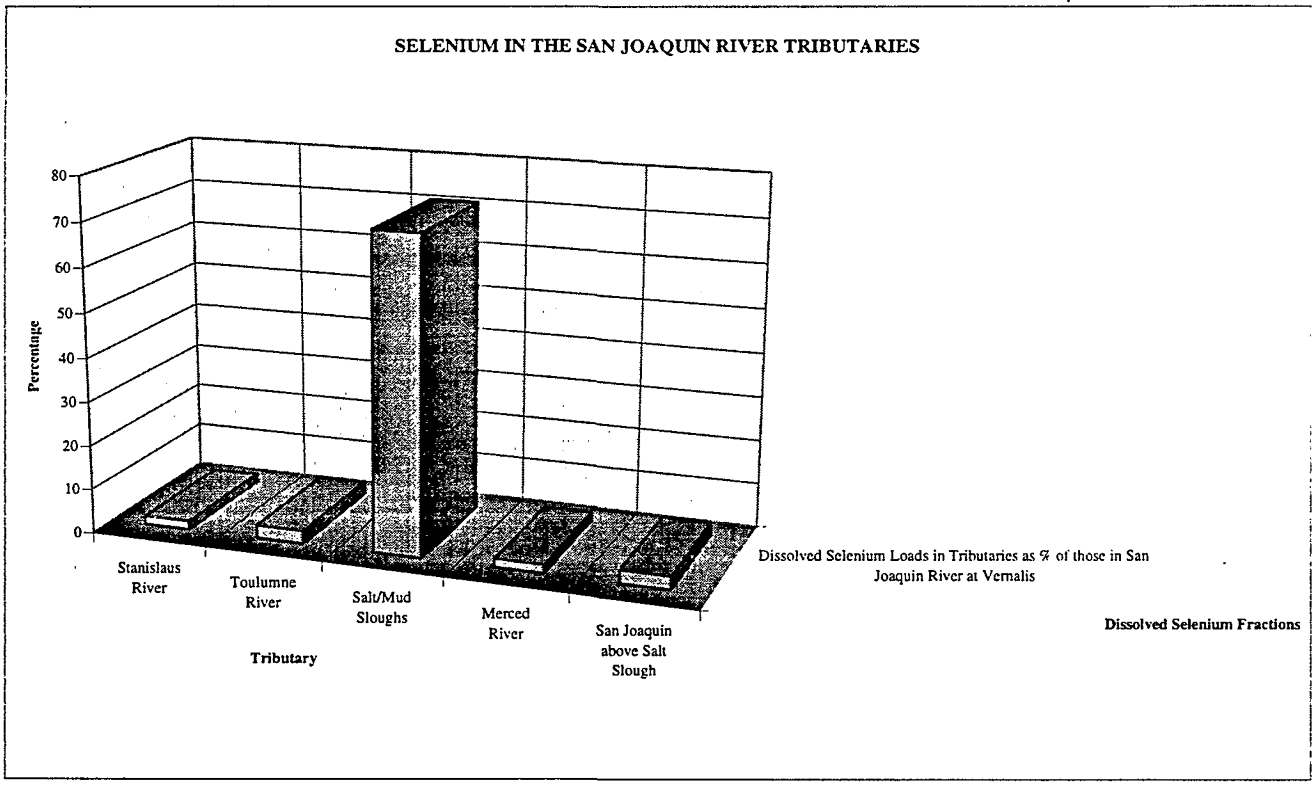
B - Further literature review required.

- Source does not contribute significant load of constituent in this watershed.



SELENIUM TABLE - 2		
Selenium in the San Joaquin River Tributaries		
Tributary	**Dissolved Selenium Loads in Tributaries as % of those in San Joaquin River at Vernalis**	**Note**
Stanislaus River	2	*1*
Toulumne River	3	*1*
Salt/Mud Sloughs	71	*1*
Merced River	2	*1*
San Joaquin above Salt Slough Confluence	3	*1*

Note 1: Values obtained from the U.S. Geological Survey Water Resources Investigation Report 88-4186



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D-037382

D-037382

Selenium Loading Notes

1. Data available; flow and concentration data available; load calculations required.

2. None of the references on mine drainage reviewed by the consultant team indicated that selenium was a significant constituent of mine drainage waters.

3. Selenium is not usually detected in municipal wastewaters or most industrial wastewaters but it is found in oil refinery wastewater. Municipal and industrial wastewaters are probably an insignificant source in the Delta. See Note 18 for more information.

4. Most urban runoff sampling studies have not included selenium. Selenium was not measured in the 1980s in EPA's National Urban Runoff Program (NURP). Selenium data was included in the most recent urban runoff monitoring in Sacramento as reported in "Sacramento NPDES Stormwater Discharge Characterization Program, 1996 Update Report" prepared for the city of Sacramento by Larry Walker and Associates. Some selenium concentration measurements were made in the cities of Eugene and Portland in the early 1990s. Selenium was not detected in any Eugene samples. A few measurements of 0.001 and 0.002 mg/l were recorded in Portland with a detection limit 0.001 mg/l. The data indicates that selenium is not present in urban runoff in high concentrations and is probably not significant compared to emissions from oil refineries and certain agricultural areas. In order to obtain a more precise estimate of selenium in urban runoff, additional monitoring is needed using a low detection limit.

5. Further literature review required.

6. See Note 1 for explanation.

7. See Note 2 for explanation.

8. Selenium is not usually detected in municipal wastewaters or most industrial wastewaters but it is found in oil refinery wastewater. Municipal and industrial wastewaters are probably an insignificant source in the Sacramento Basin. See Note 18 for more information.

9. See Note 4 for explanation.

10. Reported in Table 19 of "State of the Estuary: A report on conditions and problems in San Francisco Bay/Sacramento-San Joaquin Delta Estuary" San Francisco Estuary Project, 1992.

11. See Note 1 for explanation.

12. See Note 2 for explanation.

13. Selenium is not usually detected in municipal wastewaters or most industrial wastewaters but it is found in oil refinery wastewater. Municipal and industrial wastewaters are probably an insignificant source in the San Joaquin Basin. See Note 18 for more information.

Selenium Loading Notes

14. See Note 4 for explanation.

15. Selenium load in the San Joaquin River at Vernalis is reported as 4.6 tons/year in U. S. Geological Survey Water-Resources Investigations Report 88-4186. The same value for input to San Francisco Bay from the delta is reported in Table 19 of "State of the Estuary: A report on conditions and problems in San Francisco Bay/Sacramento-San Joaquin Delta Estuary" San Francisco Estuary Project, 1992.

16. Agricultural drainage is an insignificant source of wastewater in the Bay Area.

17. See Note 2 for explanation.

18. Selenium loads to San Francisco Bay are reported in "Mass Emissions Reduction Strategy for Selenium" prepared by San Francisco Bay RWQCB in 1992. The loads are estimated as 7.1 kg/day from oil refineries, 2.2 kg/day from municipal wastewater treatment plants and 2 kg/day from riverine sources under average flow conditions. No selenium was detected in samples of municipal wastewater. The RWQCB assumed that it was present in municipal wastewater at the detection limit used in the analyses and thus calculated 2.2 kg/day. The RWQCB noted this was a probable overstatement. It is worth noting that the estimated load to the bay from riverine sources (1,600 lbs/yr) is much lower than the sum of the Sacramento and San Joaquin River inputs to the Bay-Delta system (11,000 lbs/yr reported in "State of the Estuary: A report on conditions and problems in San Francisco Bay/Sacramento-San Joaquin Delta Estuary" San Francisco Estuary Project, 1992. Perhaps, this is attributable chemical reactions and biological uptake in the Delta.

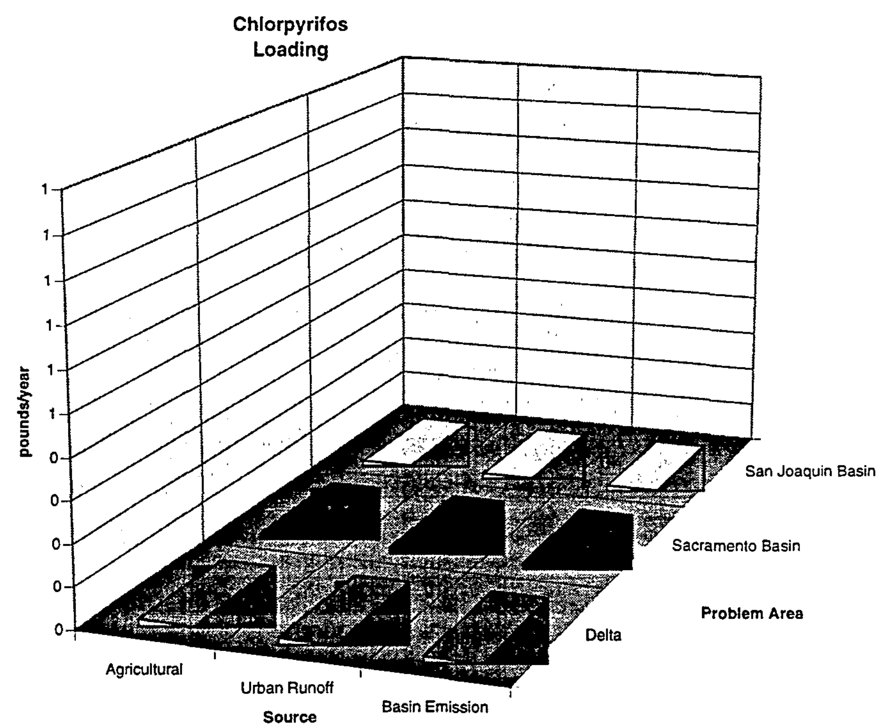
19. See Note 4 for explanation.

20. See Note 5 for explanation.

21. See Note 5 for explanation.

CHLORPYRIFOS LOADING TABLE						
			Chlorpyrifos Loading (pounds/year)			
Source	**Delta**	**Note**	**Sacramento Basin**	**Note**	**San Joaquin Basin**	**Note**
Agricultural	B	*1*	A	*4*	A	*7*
Urban Runoff	A	*2*	A	*5*	A	*8*
Total Load						
Basin Emission	B	*3*	B	*6*	B	*9*

Note: Numerical values listed in italics under the Note column provide the background and references associated with the accompanying load
A - Data available; flow and concentration data available; load calculations required.
B - Further literature review required.
- Source does not contribute significant load of constituent in this watershed.



Chlorpyrifos Loading Notes

General Notes

- Applied to almond orchards in January and February and again in May through August.
- Applied to alfalfa fields in March.
- Particle bound compound.

1. Further literature review required.

2. One study (Conner, 1996) reports chlorpyrifos concentrations in urban runoff from the cities of Stockton and Sacramento and the San Francisco Bay Area. The concentration from the City of Stockton could be used to calculate a load for the Delta. However, further investigation is required to determine if discharge data can be matched to the sampling events and locations.

3. See Note 1 for explanation.

4. Chlorpyrifos concentration data is reported for the Sacramento River at Sacramento in USGS Open File Report 95-110. The sampling frequency was monthly for the period 1991-1994. Discharge data for the Sacramento River is available. Load calculations are in progress.

5. See Note 2 for explanation.

6. See Note 1 for explanation.

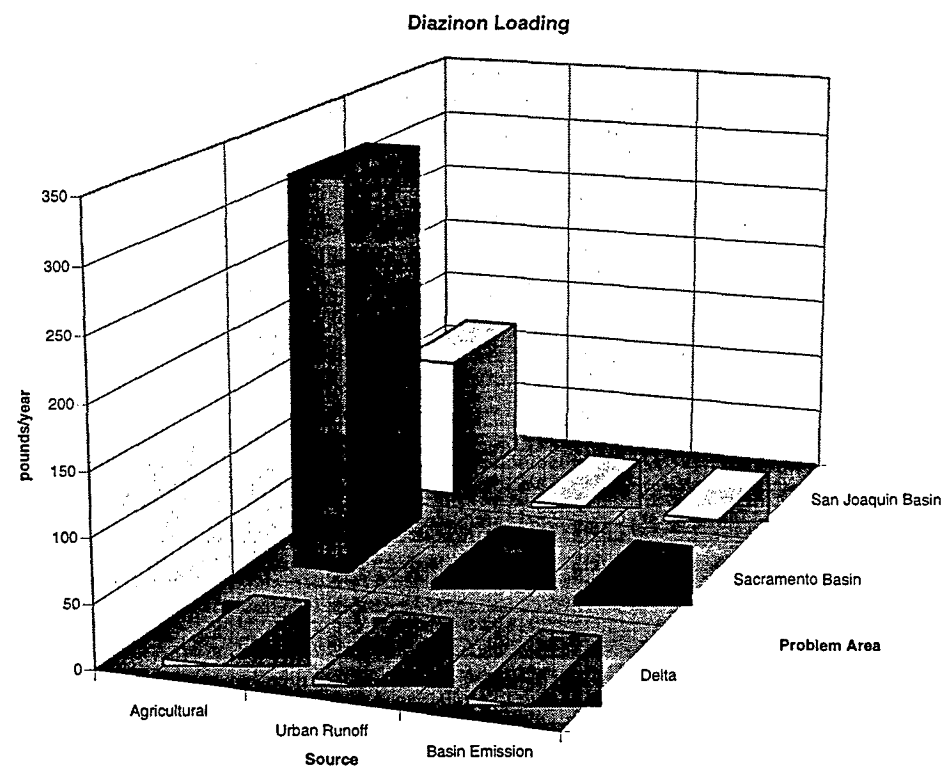
7. Several studies report chlorpyrifos concentration in the San Joaquin river at various locations (USGS, 1995, Open File Report 95-165); (USGS, 1995, Open File Report 95-110); (Foe, Detection of Pesticides in the San Joaquin Basin); (Department of Pesticide Regulation, 1991-1993, San Joaquin River Study). Further investigation is required to determine if discharge data can be matched to the sampling events and locations.

8. See Note 1 for explanation.

9. See Note 1 for explanation.

DIAZINON LOADING TABLE						
	Diazinon Loading (pounds/year)					
Source	**Delta**	**Note**	**Sacramento Basin**	**Note**	**San Joaquin Basin**	**Note**
Agricultural	B	*1*	319	*4*	116	*7*
Urban Runoff	A	*2*	A	*5*	B	*8*
Total Load			319		116	
Basin Emission	B	*3*	B	*6*	B	*9*

Note: Numerical values listed in italics under the Note column provide the background and references associated with the accompanying load
A - Data available; flow and concentration data available; load calculations required.
B - Further literature review required.
[ ] - Source does not contribute significant load of constituent in this watershed.



Diazinon Loading Notes

General Notes

- Applied to almond orchards in January and February and again in May through August.
- Applied to alfalfa fields in March.

1. Further literature review required.

2. One study (Conner, 1996) reports diazinon concentrations in urban runoff from the cities of Stockton and Sacramento and the San Francisco Bay Area. The concentration from the City of Stockton could be used to calculate a load for the Delta. However, further investigation is required to determine if discharge data can be matched to the sampling events and locations.

3. See Note 1 for explanation.

4. Loads were estimated based on measured diazinon concentrations and measured streamflows. Diazinon concentrations in the San Joaquin River at Vernalis were obtained from The USGS WATSTOR database and the USGS Open File Report 95-110. Diazinon data in the Sacramento River at Sacramento were obtained from the USGS Open File Report 95-110. Flows in the Sacramento River are from the USGS gage at Freeport (#11447650). Flows in the San Joaquin River are from the USGS gage at Vernalis (#11303500). At Vernalis loads were estimated for years 1991, 1993, and 1994. The average is reported in the table. At Sacramento loads were estimated for 1993 and 1994 and the average reported. Note, the estimated diazinon load at Sacramento includes urban runoff from Sacramento and surrounding areas in addition to agricultural runoff. Non-detect data was not included in the loads analysis.

5. See Note 2 for explanation.

6. See Note 1 for explanation.

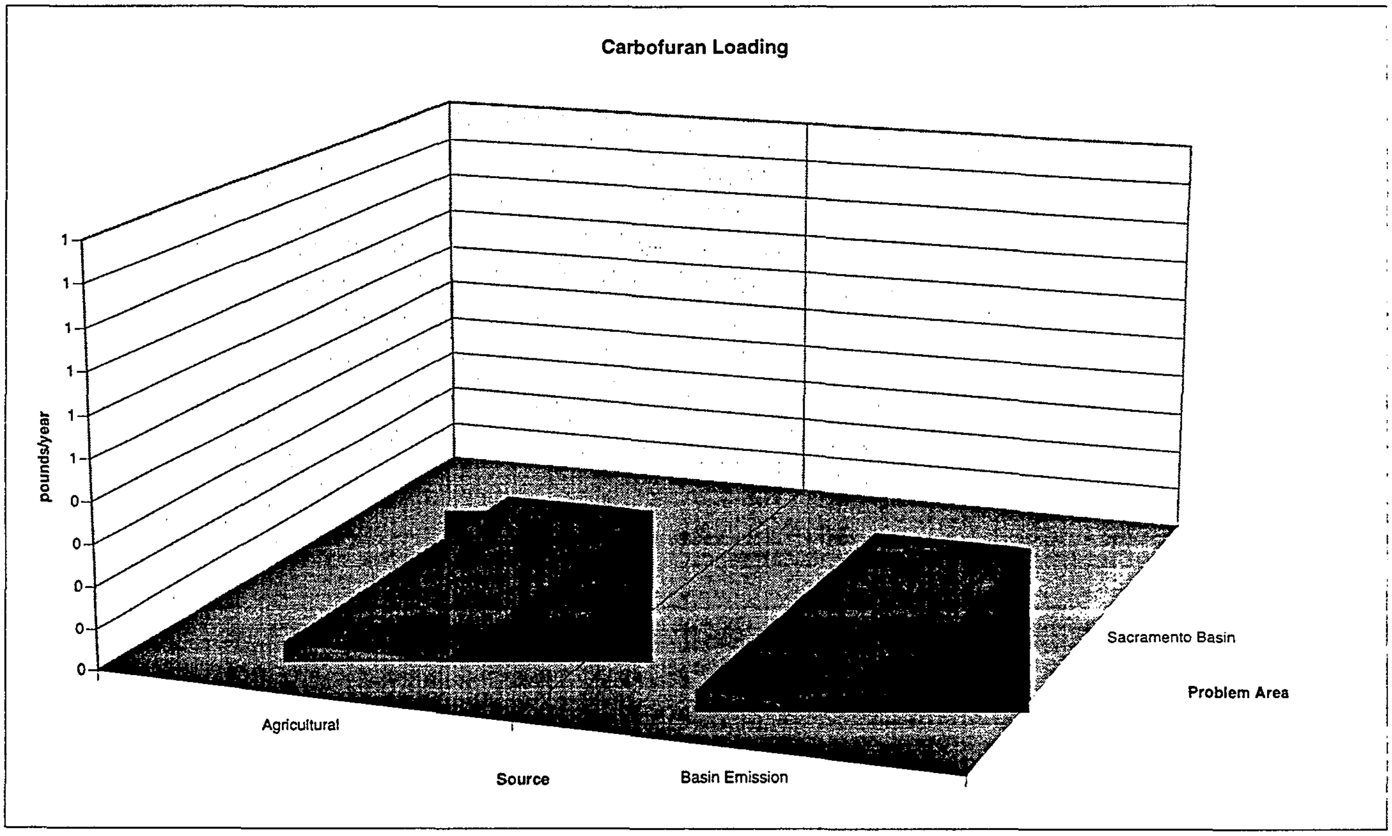
7. See Note 4 for explanation.

8. See Note 1 for explanation.

9. See Note 1 for explanation.

CARBOFURAN LOADING TABLE		
	Carbofuran (pounds/year)	
Source	**Sacramento Basin**	**Note**
Agricultural	A	*1*
Total Load		
Basin Emission	A	*2*
Total Load		

Note: Numerical values listed in italics under the Note column provide the background and references associated with the accompanying load
A - Data available; flow and concentration data available; load calculations required.



Carbofuran Loading Notes

General Notes

- Applied to alfalfa fields in March and to rice fields from April through June.

1. Several studies report carbofuran concentrations detected in the Sacramento River at various locations (USGS, 1995, Open File Report 95-110); (Crepeau et. al.); (Department of Fish and Game, Rice Pesticide Concentrations in the Sacramento River and Associated Agricultural Drains); (Department of Water Resources, August 1989). Discharge data is available for many of the locations where carbofuran was sampled. Load calculations are in progress.

2. See Note 1 for explanation.

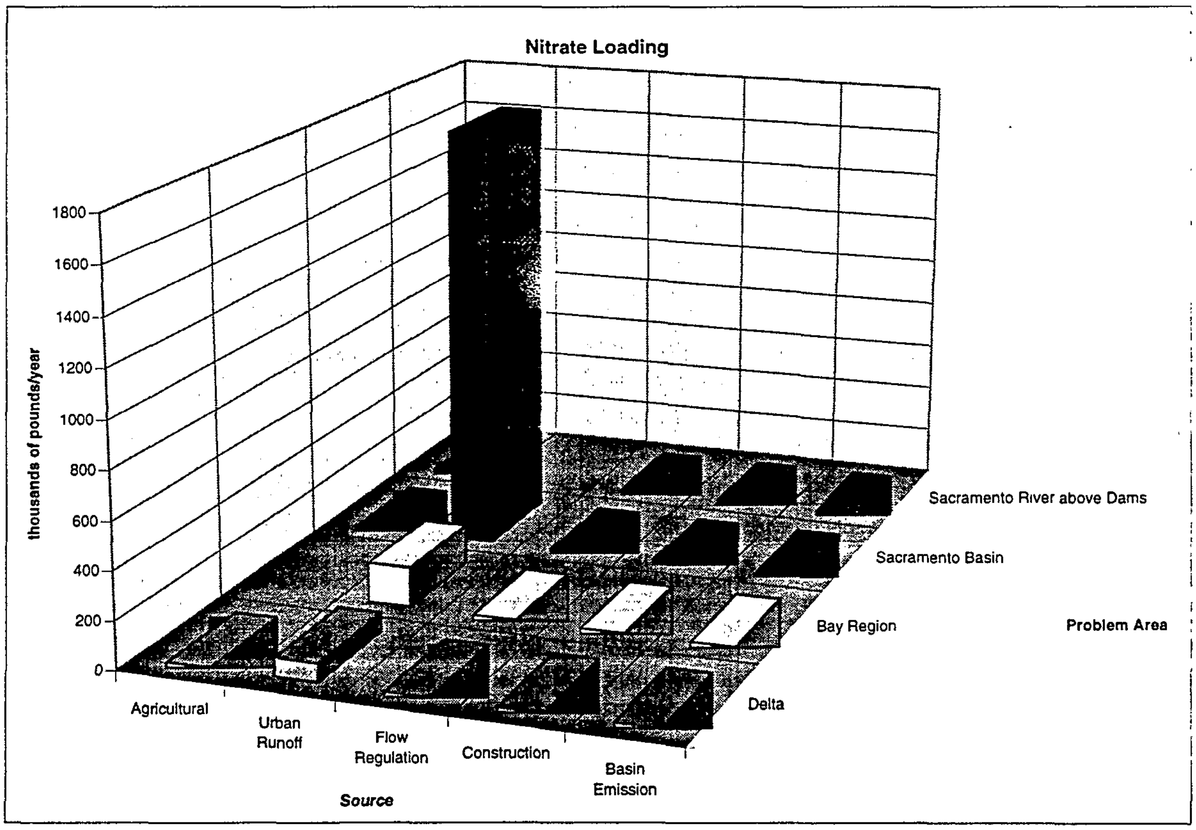
NITRATE LOADING TABLE								
	Nitrate Loading (thousands of pounds/year)							
Source	**Delta**	**Note**	**Bay Region**	**Note**	**Sacramento Basin**	**Note**	**Sacramento River above Dams**	**Note**
Agricultural	A	*1*		*6*	B	*11*	B	*16*
Urban Runoff	77	*2*	166	*7*	1790	*12*		*17*
Flow Regulation	B	*3*	B	*8*	B	*13*	B	*18*
Construction	B	*4*	B	*9*	B	*14*	B	*19*
Total Load	77				1790			
Basin Emission	B	*5*	B	*10*	B	*15*	B	*20*

Note: Numerical values listed in italics under the Note column provide the background and references associated with the accompanying

A - Data available; flow and concentration data available; load calculations required.

B - Further literature review required.

[shaded box] - Source does not contribute significant load of constituent in this watershed.



x:\calfed\LOADTBLS.XLS\nitrate

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Nitrate Loading Notes

1. Nitrate concentrations are available from various sampling locations within the Delta and at the San Joaquin River inflow to the Delta. Most of this data can be found at the Interagency Ecological Program web site. Work is in progress to acquire matching discharge data and calculate loads.

2. Nitrate loads were calculated by Woodward-Clyde for the Contra Costa Clean Water Program (Contra Costa Clean Water Program, 1994). The loads assessment model is based upon a relationship between rainfall quantities, runoff pollutant concentrations, and the relationship between pollutant loads and land use. The loads assessment model contains the following assumptions:

- Uniform precipitation between isohyets
- Constant runoff coefficient based upon land use
- Runoff water quality was constant for each land use
- Isohyetals based on average annual precipitation

The reported load in the loading table is from Figure 4-1 of the report (Contra Costa Clean Water Program, 1994).

3. Further literature review required.

4. See Note 3 for explanation.

5. See Note 3 for explanation.

6. Source does not contribute significant load of constituent in this watershed.

7. See Note 2 for explanation.

8. See Note 3 for explanation.

9. See Note 3 for explanation.

10. See Note 3 for explanation.

11. See Note 3 for explanation.

12. Nitrate loads were calculated for the Sacramento NPDES Stormwater Discharge Characterization Program (Larry Walker & Associates). Loads were initially calculated in 1992 using the following methodology:

- Regression models were developed showing the relationship of urban runoff pollutant discharge factors.

Nitrate Loading Notes

- The regression equations were then used as input to a continuous simulation model for Sacramento urban runoff mass loading over a 58 year period.
- The model was refined in 1996, using the updated database of urban runoff monitoring data available form the Sacramento NPDES Stormwater Monitoring Program. the load reported in the loading table is from Table 15 of the report (Larry Walker & Associates).

13. See Note 3 for explanation.

14. See Note 3 for explanation.

15. See Note 3 for explanation.

16. See Note 3 for explanation.

17. See Note 6 for explanation.

18. See Note 3 for explanation.

19. See Note 3 for explanation.

20. See Note 3 for explanation.

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RESULTS INTERNET SEARCH WATER QUALITY DATA SACRAMENTO & SAN JOAQUIN BASIN			
RESOURCE/AGENCY/DEPARTMENT	**ADDRESS**	**RELEVANT SUBJECTS/CATEGORIES**	**REVIEW RESULTS**
Department of Water Resources/Division of Flood Management	http://cdec.water.ca.gov	Current & Historical Data	Retrieved daily data for April for Freeport station, no monthly data available,
		Single & Group Stations	Error messages for historical data
Interagency Ecological Program	http://www.iep.ca.gov	IEP Long Term Monitoring Data	Retrieved Discrete Sampling Data for Metals, Pesticides and Water Quality &
		Discrete Water Quality Sampling	DAYFLOW data for 1984 - 1995
		DAYFLOW (estimates of net freshwater flow)	
USGS/Water Resources of California	http://water.wr.usgs.gov/	Pesticides in the Hydrologic System-National Assessment	Retrieved Summaries from NAWQA Pesticide Studies & Bibliography
		Sacramento River Basin/USGS National Water Quality Assessment	Retrieved NAWQA Study Areas, no access to Sacramento River Basin study
		Pesticide Links	No significant results from following pesticide links
California Department of Water Resources	http://wwwdwr.water.ca.gov/	Water Conditions	Retrieved Summary Report for Apr. 16 with flow data for various stations
		California Water Conditions	No relevant information from CA Water Info page
		State Water Project	Link to Operations Control Office Home Page, see below
State Water Project/Operations Control Office	http://wwwoco.water.ca..gov/	SWP Operational Reports	Retrieved monthly summary of water operations- flows for the month- for March 97
		Bay Delta Standards	Winter-Run and Delta Smelt ESA biological opinions
		Delta Hydrology and Quality Conditions	Retrieved data for the past 30 days
		Delta Environmental Compliance Reports	No access possible
State Water Resources Control Board	http://www.swrcb.ca.gov/	Plans, Policies, Staff Reports, Publications	Retrieved list of staff reports and publications
		Links to other sites	No significant results
California Environmental Resources Evaluation System	http://ceres.ca.gov/	Web Search by geographic area, theme, data type	Did a search with no significant results
California Department of Fish and Game Bay Delta and Special Projects Division	http://www.delta.dfg.ca.gov/	Bay Delta Monitoring	Only description of monitoring program, no data
CALFED/Bay-Delta Program	http://calfed.ca.gov/	Phase I Final Report, Current Phase II Alternative	No relevant information
California Rivers Assessment (CARA)	http://endeavor.des.ucdavis.edu/cara	Information by River Basin	Retrieved information for Sacramento Basin, only maps, no data